

City of Reading - Traffic Signal Maintenance Plan

The second modification corrective action is related to the pedestrian signal head visibility, as noted in example image 4. The reviewer noted that there are no visible pedestrian heads for some approaches due to the one-way streets, but that crosswalks were provided as shown in example image 5.

Example Image 4 - Compliance Spreadsheet

Categories:	Compliance Issues by Intersection Approach				Comments	Corrective Action	
	NB	SB	EB	WB		Maint.	Modification
Signal Support Offsets [2]	Y	Y	N	Y	Signal span wires and/or heads attached to wooden utility poles which are within 2' of the curb. Signal pedestal base on NW corner also within 2' of curb.		
Pedestrian Signal Heads							
Head Configuration/Meaning	N	N	N	N			
Head Size	N	N	N	N			
Head Visibility	Y	Y	Y	Y	4D.03 No visible ped head (in this case three section vehicular signal head) for pedestrians because of one-way street, yet crosswalks provided, meaning provisions for pedestrians has been determined to be necessary.		Upgrade intersection to provide pedestrian head visibility

Example Image 5 - No Pedestrian Signal Heads Visible from This Approach



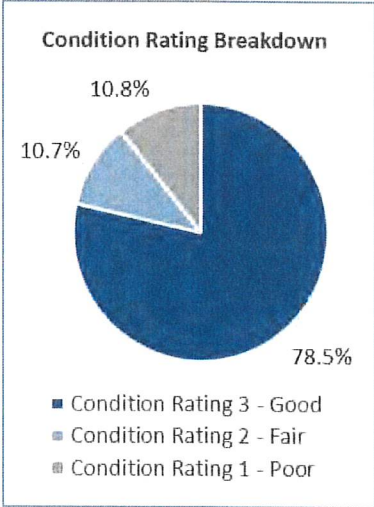
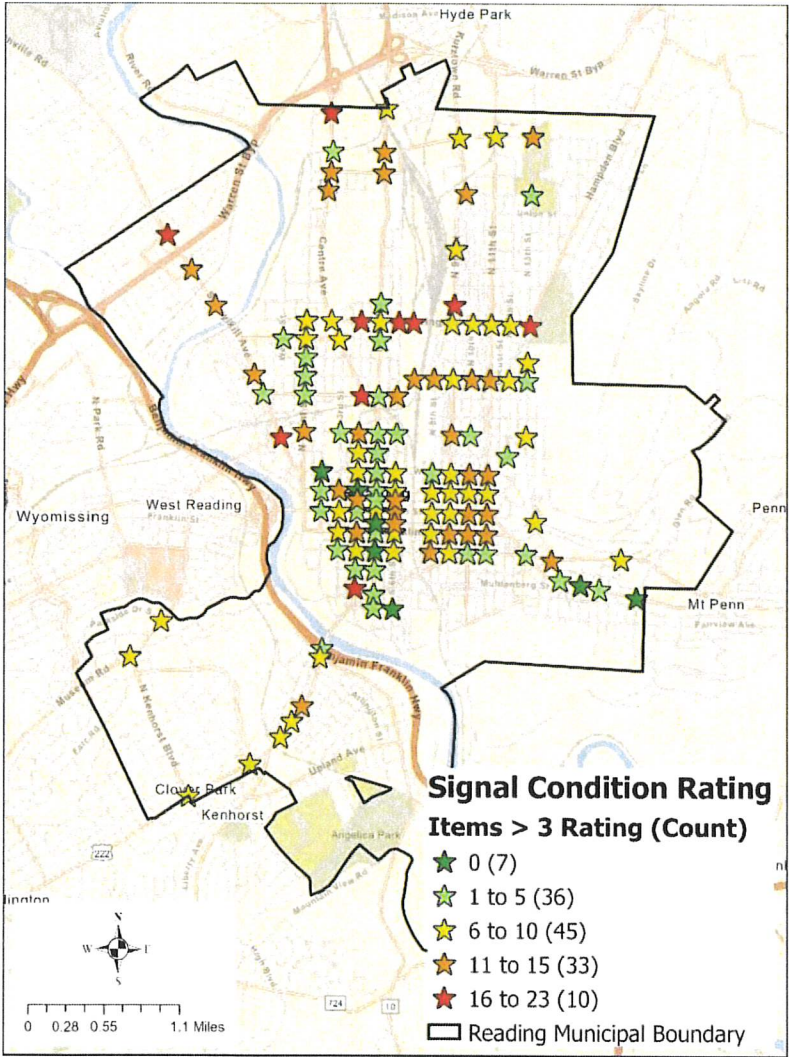
Result Summaries

Overall

For the 130 signalized intersections reviewed during the field inventory, a total of 4,840 signal items were recorded and collected across the 10 equipment categories.

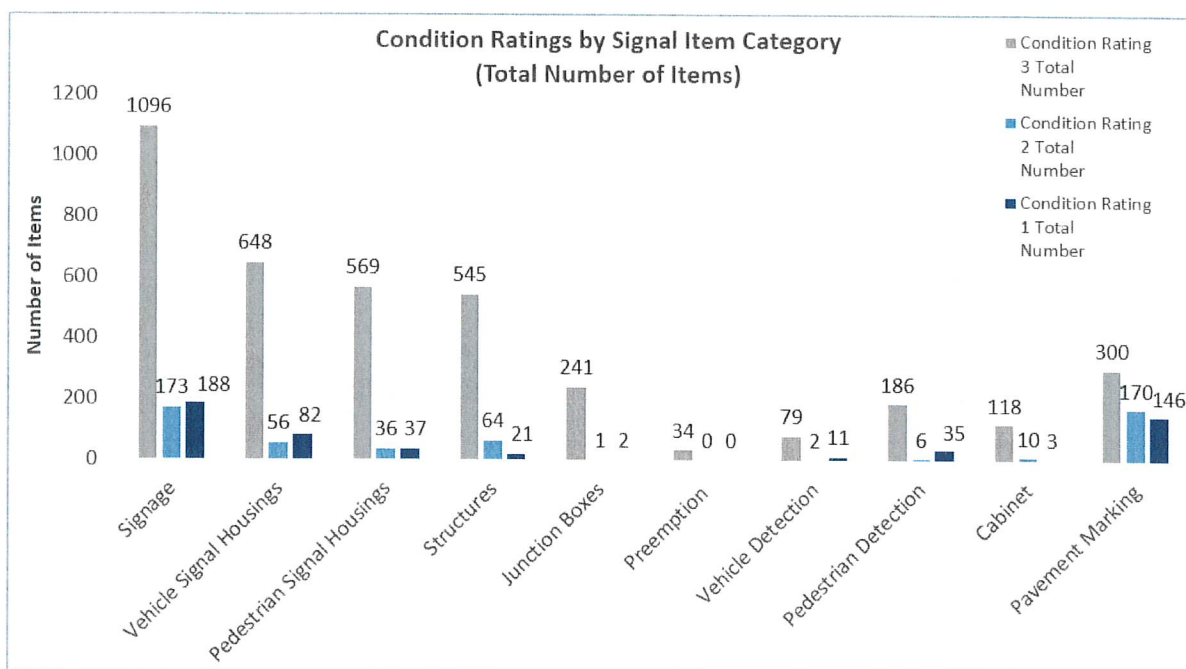
Overall, most of the signal items (78.5%) are considered Condition Rating 3 (“Good”), 10.7% of the signal items are considered Condition Rating 2 (“Fair”), and 10.8% are considered Condition Rating 1 (“Poor”).

On average, a signalized intersection in the City of Reading has 29 signal items at Condition Rating 3, four items at Condition Rating 2, and four items at Condition Rating 1.

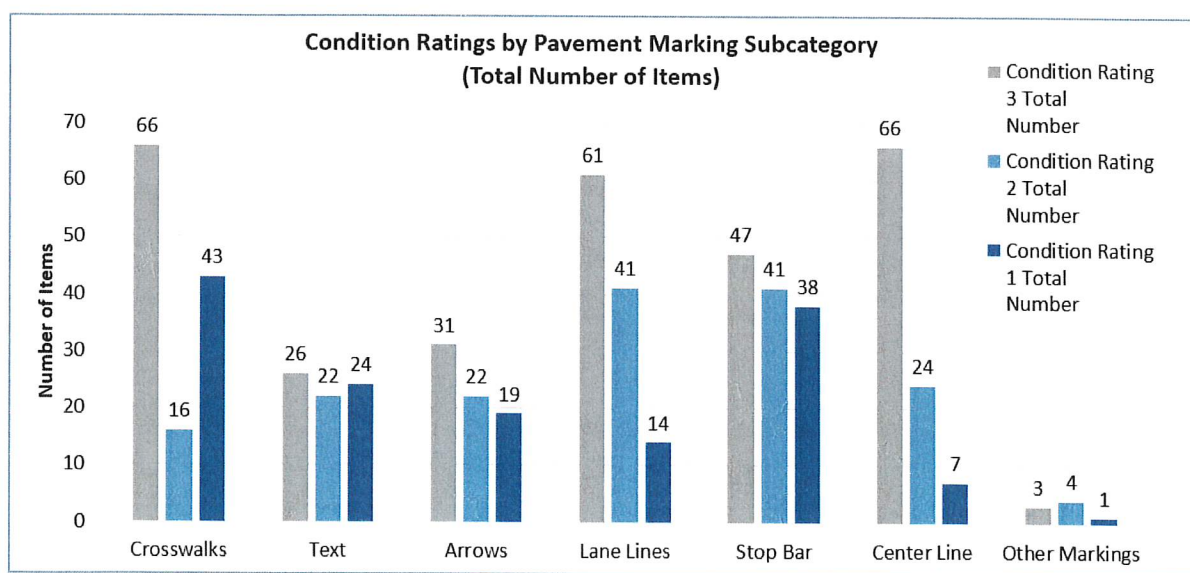


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The signal item category with the greatest number of recorded items was Signage, with 1,457 items. Of this category, 75% (1,096) of the items were Condition Rating 3, while 12% (173) were Condition Rating 2 and 13% (188) were Condition Rating 1. The rest of the categories experienced a similar condition rating distribution, with most of the items rated as Condition Rating 3. A summary of the condition ratings by signal item category is shown in the figure below and the table on the following page.



As described, the pavement marking category was further subdivided into seven sub-categories. Each “item” counted within each subcategory represents all markings within that subcategory. A summary of the condition ratings by pavement marking subcategory is shown in the figure below and the table on the following page.



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Signal Item Condition Rating Summary Table – by Signal Item Category

Signal Item Category	Total Items		Condition Rating 3 (Good)			Condition Rating 2 (Fair)			Condition Rating 1 (Poor)			Permit Non-Matching	
	Total	Avg.	Total	Avg.	% of Total	Total	Avg.	% of Total	Total	Avg.	% of Total	Total	Avg.
Signage	1457	11	1096	9	75%	173	2	12%	188	3	13%	469	5
Veh. Signal Housings	786	6	648	5	82%	56	2	7%	82	2	10%	17	3
Ped. Signal Housings	642	5	569	5	89%	36	1	6%	37	1	6%	22	2
Structures	630	5	545	5	87%	64	2	10%	21	2	3%	18	2
Junction Boxes	244	2	241	4	99%	1	1	0%	2	1	1%	0	0
Preemption	34	0	34	1	100%	0	0	0%	0	0	0%	0	0
Vehicle Detection	92	1	79	2	86%	0	0	0%	13	3	14%	2	2
Pedestrian Detection	227	2	186	4	82%	6	3	3%	35	3	15%	9	2
Cabinet	131	1	118	1	90%	10	1	8%	3	1	2%	1	1
Pavement Marking	616	5	300	2	49%	170	1	28%	146	1	24%	53	0
Crosswalks	125	1	66	1	53%	16	1	13%	43	1	34%	1	1
Text	72	1	26	1	36%	22	1	31%	24	1	33%	20	2
Arrows	72	1	31	1	43%	22	1	31%	19	1	26%	17	2
Lane Lines	116	1	61	1	53%	41	1	35%	14	1	12%	4	1
Stop Bar	126	1	47	1	37%	41	1	33%	38	1	30%	4	1
Center Line	97	1	66	1	68%	24	1	25%	7	1	7%	2	2
Other Markings	8	0	3	0	38%	4	1	50%	1	1	13%	5	2
TOTAL	4859	37	3816	29	78.5%	516	4	10.6%	527	4	10.8%	591	5

Field Condition Keywords

Field comments were provided for signal items rated as Condition Rating 2 and Condition Rating 1. These keywords from these comments were evaluated to identify the key issue(s) across the signal items. The most frequent keywords for each signal item category are summarized below:

Signal Item Category	Frequent Keywords	% of Items Rated 1 or 2
Signage	Discolored	67.0%
	Worn	36.0%
	Faded	29.0%
	Cracked	18.0%
	Peeling	17.0%
Vehicle Signal Housings	Broken Visor(s)	52.7%
	Missing Visor(s)	36.4%
Pedestrian Signal Housings	Broken Visor(s)	37.2%
	Missing Visor(s)	23.3%
Structures	Rusted	56.4%
	Dented	17.9%
	Bent	12.8%
Junction Boxes	Lid Broken	66.7%
	Replaced by Wood	33.3%
	Lid Cracked	33.3%
Vehicle Detection	Faulted	66.7%
	Disabled	16.7%
Pedestrian Detection	Buttons Jammed	33.3%
	Missing Buttons/ Button Covers	26.7%
	Buttons Worn	20.0%
Cabinet	Dusty/Cobwebs	41.7%
	Dirty	16.7%

Pvmt. Mkg. Subcategory	Frequent Keywords	% of Items Rated 1 or 2
Crosswalks	Faded	59.3%
	Worn	32.2%
	Missing	16.9%
Text	Faded	60.9%
	Worn	32.6%
	Missing	26.1%
Arrows	Faded	68.3%
	Worn	29.3%
	Missing	29.3%
Lane Lines	Faded	45.5%
	Worn	41.8%
	Missing	12.7%
Stop Bar	Faded	48.8%
	Worn	37.5%
	Missing	27.5%
Center Line	Missing	40.6%
	Faded	34.4%
	Worn	15.6%
Other Markings	Worn	40.0%
	Goring	40.0%
	Faded	40.0%

Of the 15 categories, Signage had the greatest number of comments, with the most frequent keywords being discolored signs, worn signs, and faded signs.

Of the seven pavement subcategories, the most frequent keywords were faded markings, worn markings, and missing markings. Faded markings was the most frequent keywords used.



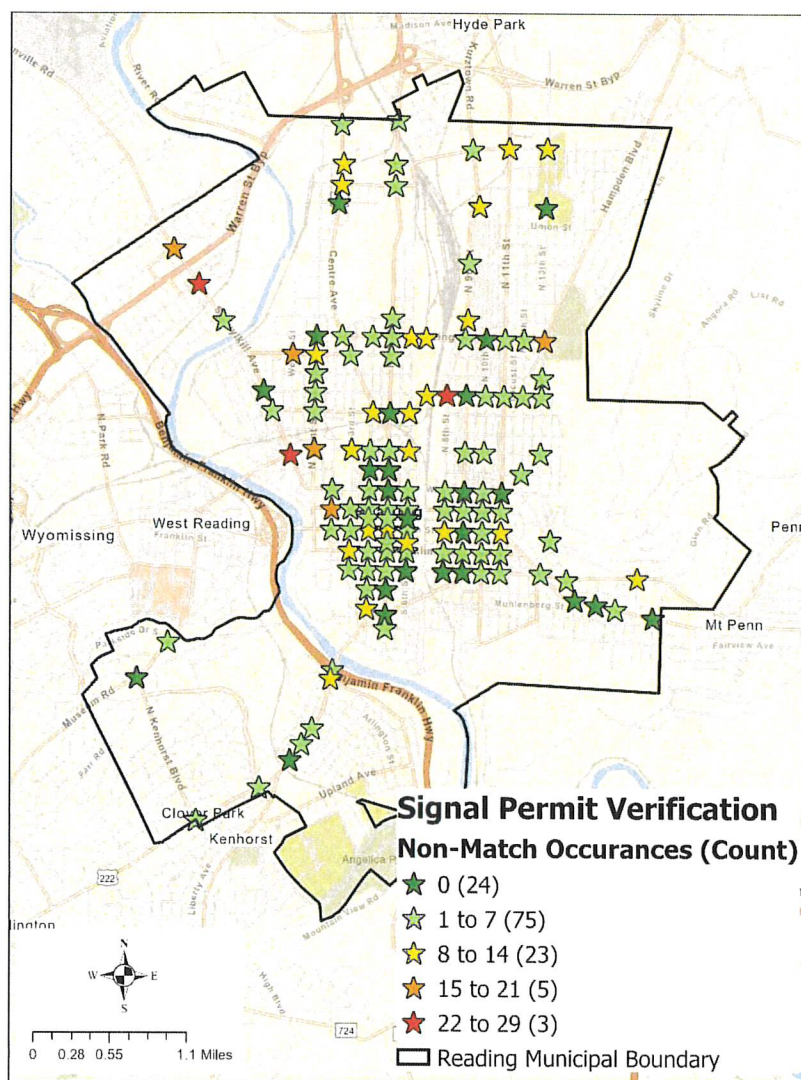
Non-Matching Permits

Part of the field inventory consisted of verifying on-street information against the TSAMS database and the signal permit. 591 signal items were found to not match the signal permit (“non-matching” between the permit and what was inventoried in the field), with an average of five non-matching items per intersection. The signal item category with the greatest number of differences is Signage at 469 items (79% of all non-matching item).

Of the 469 “non-matching” Signage items:

- 303 items were shown on the signal permit but missing from the field;
- 121 items were missing from the signal permit but inventoried in the field.

The second highest category is Pavement Markings with 53 items (9%) “non-matching” between the signal permits and the field inventories. Pavement Text and Pavement Arrows were found to be the two subcategories experiencing the most differences between the field and the permits. A summary of the field permit verification is provided in Table 2.



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Signal Permit Field Verification Table -- by Signal Item Category

Signal Item	Permit Keyword Occurrence							
	Missing from Field		Missing from Permit		Different from Permit		Other	
	Total	Percentage	Total	Percentage	Total	Percentage	Total	Percentage
Signage	303	65%	121	26%	32	7%	13	3%
Vehicle Signal Housings	7	41%	10	59%	0	0%	0	0%
Pedestrian Signal Housings	0	0%	7	32%	15	68%	0	0%
Structures	1	6%	12	67%	3	17%	2	11%
Vehicle Detection	0	0%	0	0%	2	100%	0	0%
Pedestrian Detection	2	22%	3	33%	2	22%	2	22%
Cabinet	0	0%	1	100%	0	0%	0	0%
Crosswalks	0	0%	0	0%	1	100%	0	0%
Pavement	11	21%	30	58%	11	21%	0	0%
Text	6	30%	11	55%	3	15%	0	0%
Arrows	5	29%	10	59%	2	12%	0	0%
Lane Lines	0	0%	0	0%	4	100%	0	0%
Stop Bar	0	0%	2	50%	2	50%	0	0%
Center Line	0	0%	2	100%	0	0%	0	0%
Other Markings	0	0%	5	100%	0	0%	0	0%

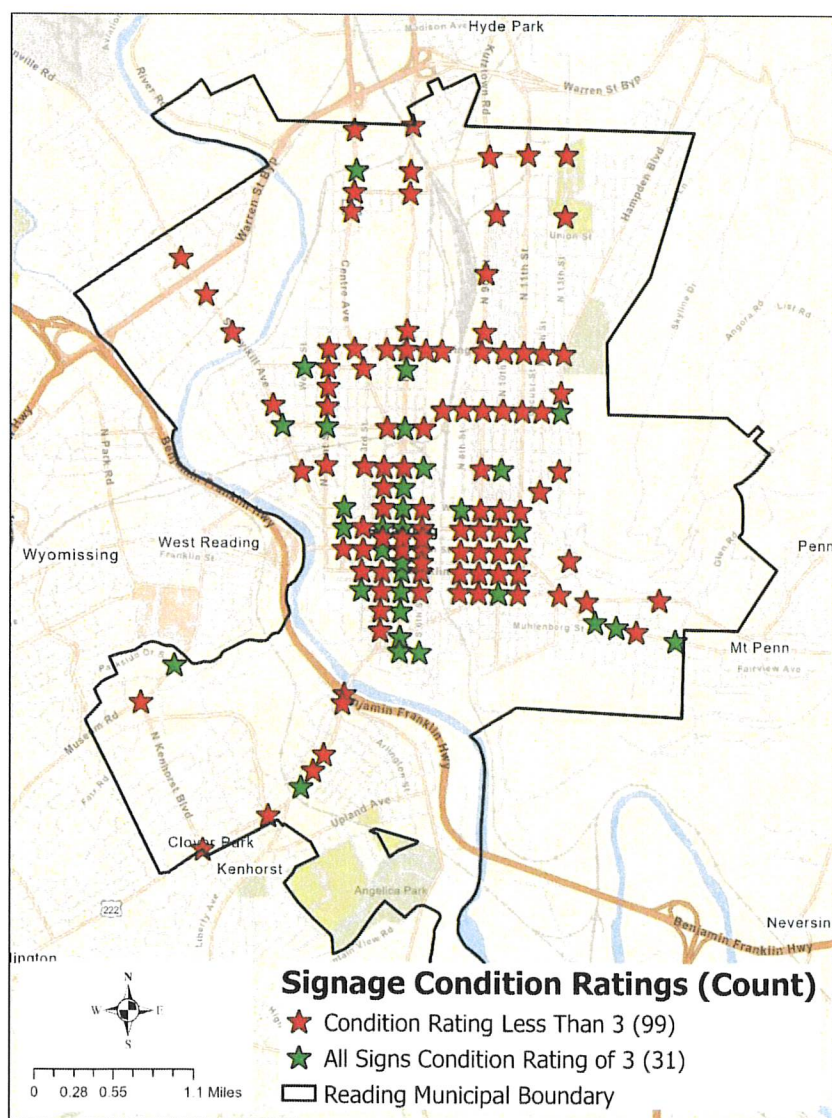
Mentioned Signs

With Signage being the signal item category with the lowest Condition Ratings and the most “non-matching” items (between the signal permits and the field inventory), the Signage was further evaluated to see if there was a pattern with a certain type of sign. The results of the analysis are provided below.

Field Items

Of the signs rated with a Condition Rating of 2 or 1, the most common signs with issues are R6-2L (Vertical Left One-Way Sign) and R6-2R (Vertical Right One-Way Sign), with 51 and 58 comment mentions, respectively. The most common issue for both of these signs is that they are worn, with 20 and 16 “worn” keyword occurrences, respectively.

Additional signs with issues include R3-7L (Left Lane Must Turn Left Sign) and R10-11 (No Turn on Red Sign), each with 30 mentions. The most common issues for both is that they are worn (6 and 14 keyword occurrences, respectively) and discolored signage (5 and 10 keyword occurrences, respectively).



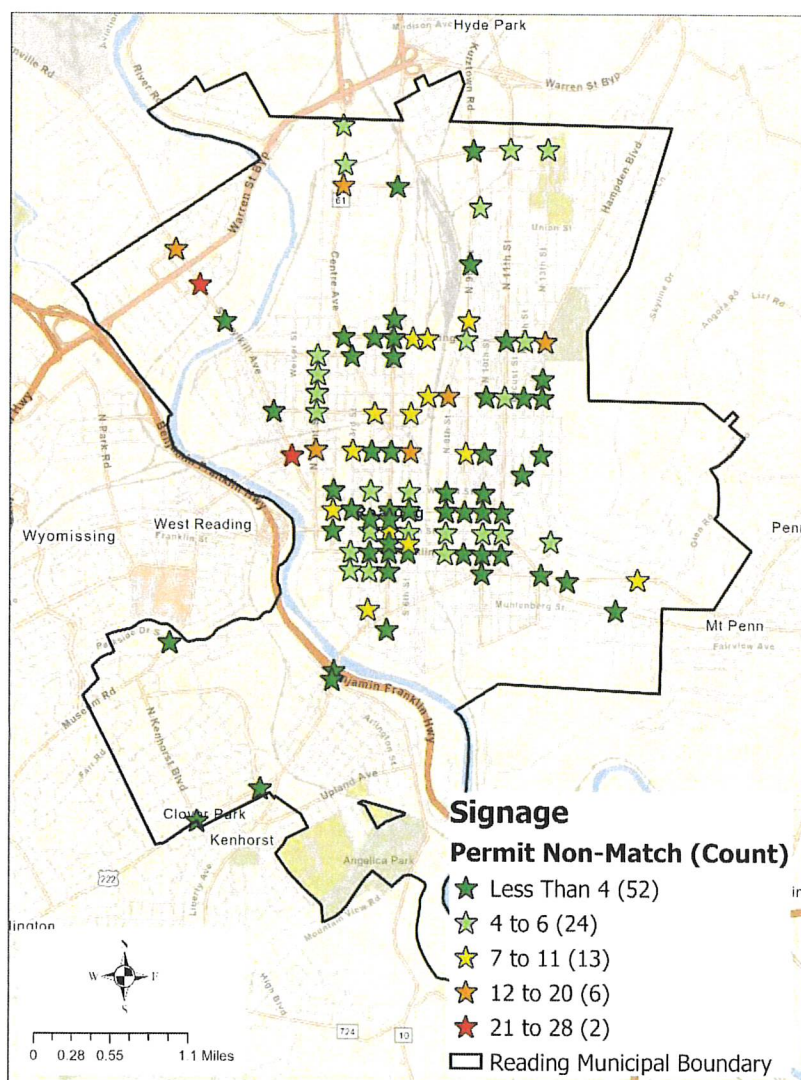
Non-Matching Permits

Of the signs found to be “non-matching” between the field inventory and the permits, the most common signs mentioned included R7-1 (No Parking Sign) and R6-2L (Vertical Left One-Way Sign), with 55 and 39 comment mentions, respectively. The most common issue for both are that the signs are missing from the field (46 occurrences and 30 occurrences, respectively).

Additional signs with issues include R3-7L (Left Lane Must Turn Left Sign), D3-1 (Street Name Sign), R7-7 (No Parking Arrow Sign), and R6-2R (Vertical Right One-Way Sign), with 41, 33, 26, and 25 mentions, respectively.

Common issues for each of these signs are as follows:

- R3-7L: Missing from Field (22 occurrences) and Missing from Permit (19 occurrences)
- D3-1: Missing from Permit (29 occurrences)
- R7-7: Missing from Field (24 occurrences)
- R6-2R: Missing from Field (16 occurrences)

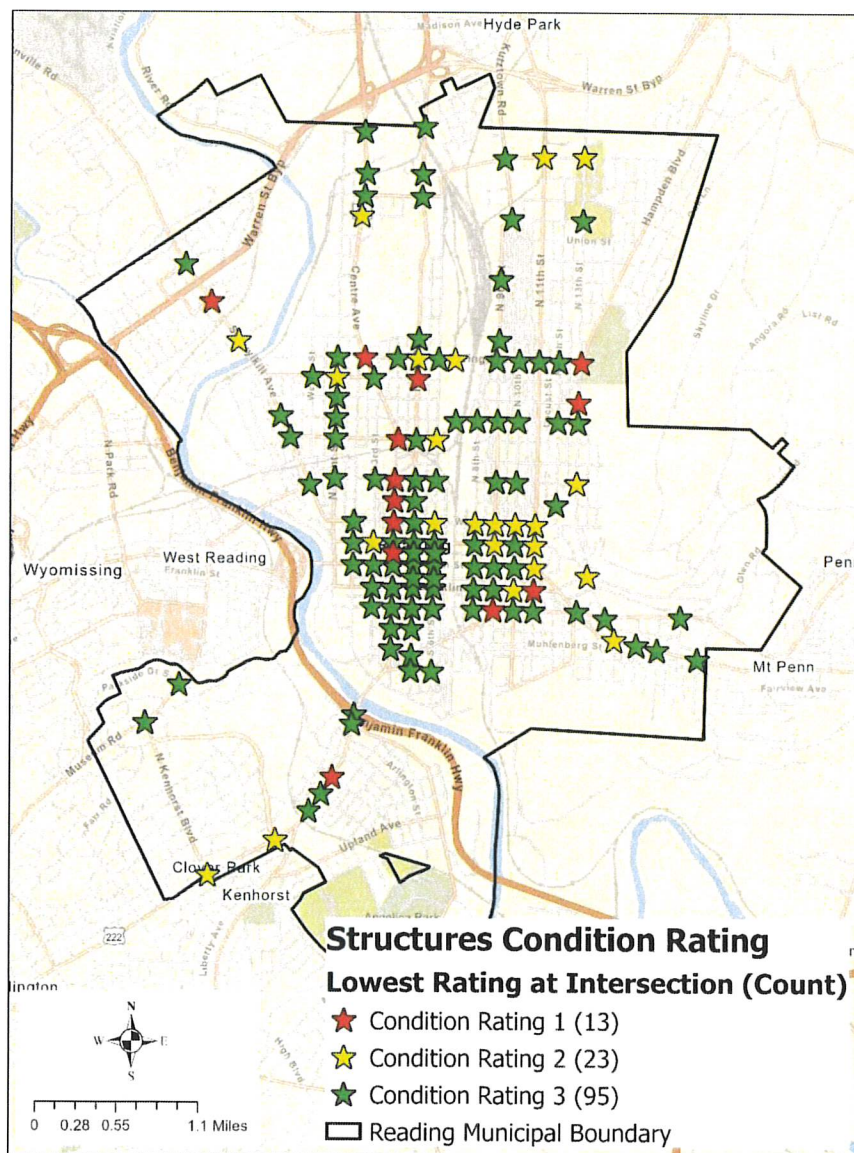


Structures

Due to a recent failure of a traffic signal structure (caused by corrosion at the foundation) in another major city in Pennsylvania, there has been a renewed focus on the regular inspection of these traffic signal assets across the Commonwealth.

Of the 630 structures assessed in the City of Reading, 64 were rated as a Condition Rating of 2 and 18 were rated as a Condition Rating of 1. "Rust" and "Dented" were the most common keywords in the comments (24 and 8 occurrences, respectively).

Of the 131 signalized intersections inventoried, 13 intersections had at least one structure rated Condition Rating 1, 23 intersection had at least one structure rated Condition Rating 2, and 95 intersections had no structures rated below Condition Rating 3.



Structures Condition Rating
Number of Structures Under 3 Rating

- ★ 0
- ★ 1 to 3
- ★ 4 to 5

□ Reading Municipal Boundary

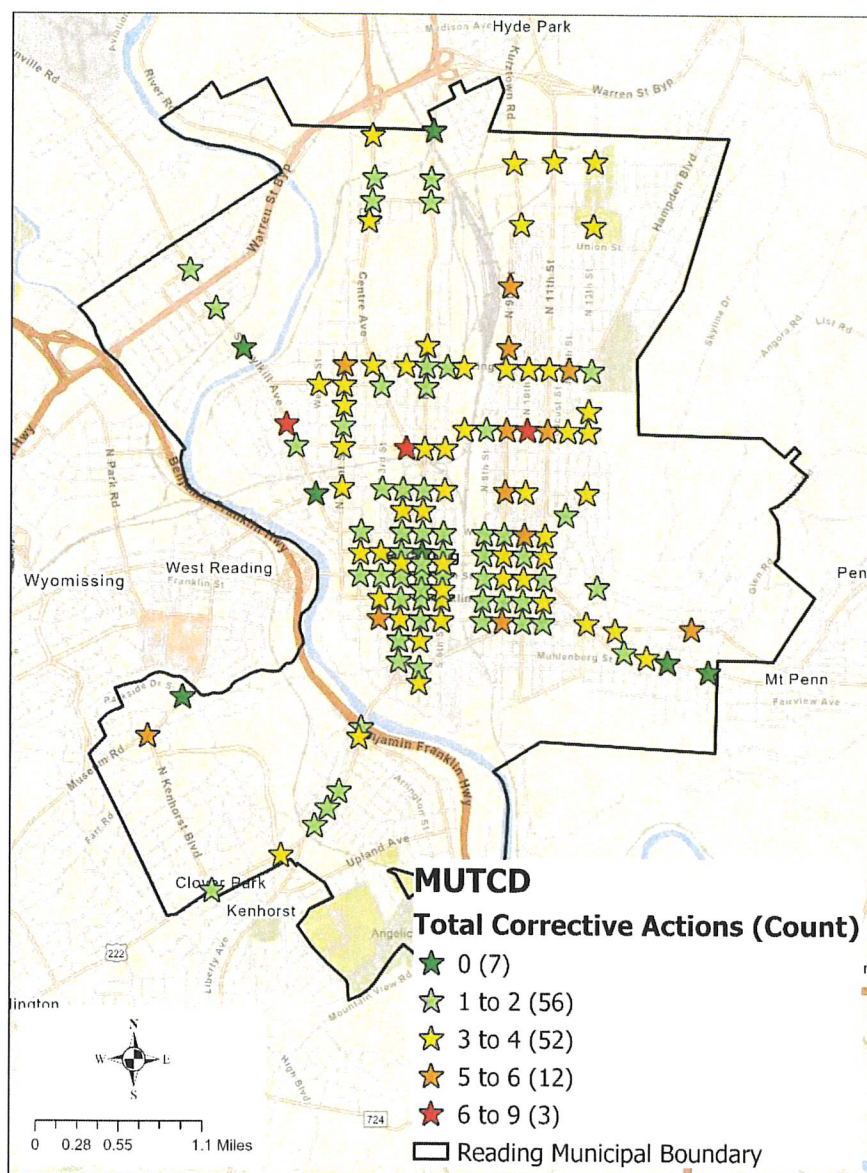


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MUTCD Compliance

There were 355 total corrective actions flagged at 123 signals to meet the national signal standards in the FHWA MUTCD. Of these actions, 189 were maintenance-related actions that only require regular maintenance activities (such as tree trimming) to remedy.

There were also 166 modification-related actions. Modification actions require making a major change or update to the signal. An example of this would be the need to add another signal head when there is only one present or the need to relocate signal poles when pole mounted signal heads are less than 2 feet from a curb. A spreadsheet containing this detailed MUTCD compliance information has been created for each intersection and can be found in Attachment B.



Maintenance Plan

There are many issues affecting the City of Reading traffic signals. Addressing all of them at once is financially infeasible. This plan will offer guidance on where budgets can achieve their greatest reach and outline a path moving forward - towards a more proactively maintained, cost effective, and efficient traffic signal system.

Strategies for Maintenance and Improvements

Goals

The City's goal is to "provide an effective and efficient traffic control system and devices that maximize safety, quality, reliability, comfort, and understandability, and minimize travel time, inconvenience, and expense for the traveling public and the taxpayers".

Decision-Making Prioritization

The City has indicated that it would like to improve as many signals as possible within their limited budget, a "best bang for the buck" scenario. This would include repairing and replacing several less-expensive assets that may be in fair condition *before* a complete restoration at a poor condition intersection. This would prevent more assets from falling into the poor category but would require higher maintenance costs for the poor equipment (or could potentially lead to a total failure of equipment and eventually higher costs on the backend).

Staffing

The City currently employs no traffic engineers for traffic signals or traffic engineering technicians. These positions are defined by the Federal Highway Administration (FHWA) as:

Traffic Engineer for Signal Systems: This is typically a supervisory and advanced professional position responsible for directing the work activities pertaining to traffic engineering and operations, including the installation, monitoring, modification, maintenance and administration of all traffic signals and signal systems within the geographic boundaries of the jurisdiction. This position ensures that signal-related maintenance activities are adequately planned and executed and that there is an adequate inventory for signal related projects.

The traffic engineer for signal systems is responsible for investigating and preparing specific recommendations for all traffic-related inquiries from both the public and governmental agencies and for providing overall traffic engineering expertise. This position plans, administers and supervises the installation, alteration, maintenance and repair of all types of traffic control devices. This position also develops and administers contracts for the installation or modification of traffic signal installations.

Traffic Engineering Technician: This position is typically responsible for advanced technical engineering support in the design of traffic signal control, communication systems and the operation of traffic signal systems. Depending on the size of the agency, there may be several traffic engineering technician positions with varying levels of expertise that correspond to designated technician levels.

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The technician position performs a variety of functions, including but not limited to the following:

- *Provides technical assistance for traffic signal design, including phasing & calc. of timing plans;*
- *Uses computer-based software programs to develop optimized timing plans for individual intersections, corridors and/or networks;*
- *Maintains signal timing database;*
- *Maintains count database;*
- *Takes and responds to calls from the public pertaining to traffic signal operation;*
- *Conducts traffic signal studies;*
- *Conducts field reviews of signalized ops. to identify problems and/or adjust timing plans; and*
- *Evaluates signal system operations in the field.*

The FHWA Traffic Signal Operations and Maintenance Staffing Guidelines recommend a staffing level of 75 to 100 signals per engineer and 30 to 40 signals per technician. These guidelines would indicate that the City needs a minimum of 1 signal engineer on staff. The recommended technician levels include a technician to provide preventative and response maintenance. The City outsources maintenance to a contractor, which reduces the staffing need to 1 highly-qualified technician or 2 entry-level technicians.

Recommended Approach

The recommended approach is broken down into three categories, highest priority, medium priority and individual intersection issues/remaining suggestions. The categories are classified by comparing safety, functionality, number of signals affected, and estimated cost. Completing each priority level before moving on to the next level is not necessary. If an opportunity arises to complete a medium or lower priority item, it is in the best interest of the city to complete any task possible.

Current Projects

The City has indicated intention to replace/repair/upgrade several signals. These intersections include:

Intersection	Description
Front and Greenwich St.	Replace the entire signal system, street lighting and upgrade ADA crosswalks at this intersection.
Front and Oley St.	Replace the entire signal system, street lighting and upgrade ADA crosswalks at this intersection.
Front and Douglass St.	Replace the entire signal system, street lighting and upgrade ADA crosswalks at this intersection.
Front and Windsor St.	Replace the entire signal system, street lighting and upgrade ADA crosswalks at this intersection.
4th and Penn St.	Replace and relocate the signal mast arm at the NW corner.
W. Windsor and Schuylkill Ave.	Install a new signalized intersection as part of the River Road Extension Project MPMS 70274
Chestnut St.	Upgrades to existing signals along Chestnut Street from 8th to 4th St. as part of the SR 2006 project.
Spring St.	Under final design by PennDOT 5-0 for upgrades to signals under the SR 2014 project.

The intersections listed above are good choices for upgrades, especially those on Front Street as these are outdated, single signal head per approach signals.



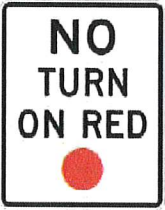
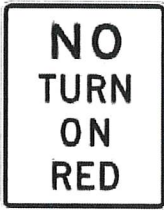



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Highest Priority

Items that have the largest impact citywide, the biggest safety improvements, or the most impactful improvements to functionality.

Signs

Replacing faded or missing signs that affect the flow of traffic such as One-Way or Left Lane Must Turn Left signs. Missing or hard to read signs are a safety issue and potential liability by making it difficult for a commuter to easily identify appropriate actions while driving. The five signs described below will have the broadest reach and the greatest impact on the safety of travelers.

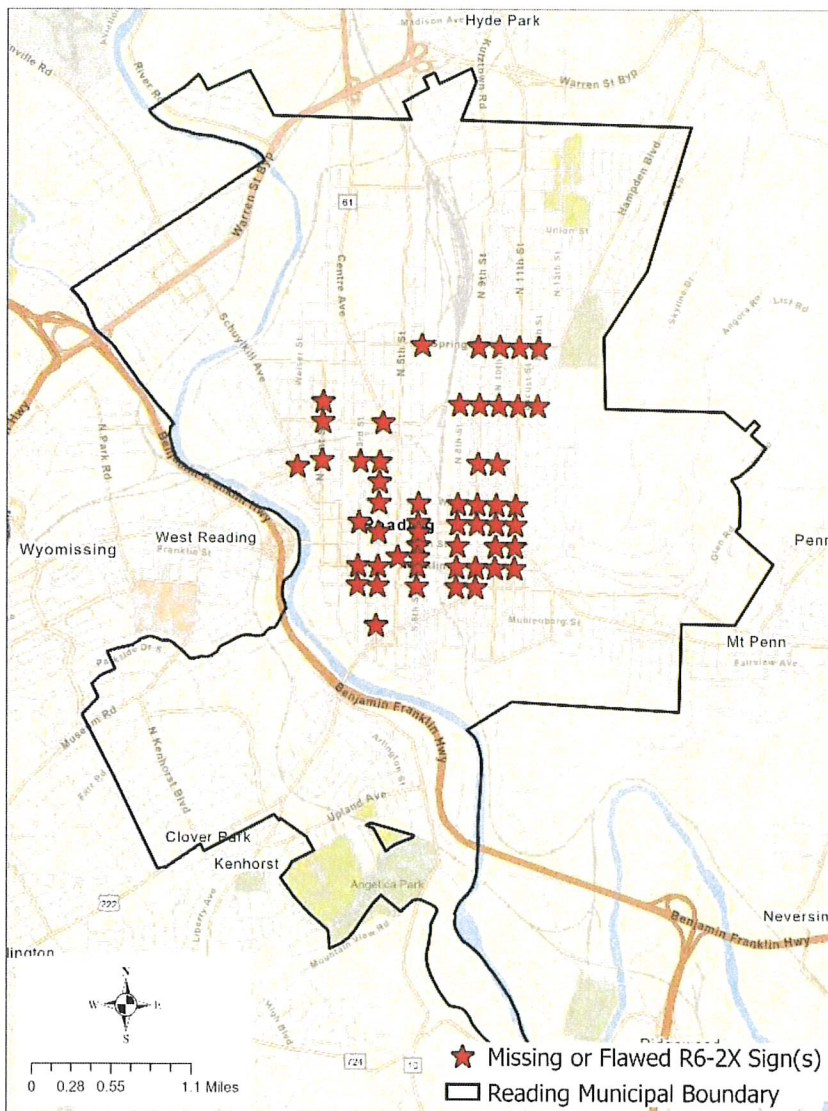
R6-2L & R6-2R (Vertical One-Way)	 
R10-11 (No Turn on Red)	  
R3-7L & R3-7R (Left Lane Must Turn Left or Right Lane Must Turn Right)	 

According to PennDOT's Engineering and Construction Management System (ECMS), in District 5 over the last 2 years, a sign generally costs between \$25 and \$225 with an average of \$81.50. The highest cost includes resetting post mounted signs which ranges from \$75 to \$225 to replace. Signs could potentially be purchased and installed by city maintenance staff at a reduced cost. Costs are also reduced when purchasing services and items in bulk.

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R6-2L & R6-2R (Vertical One-Way)

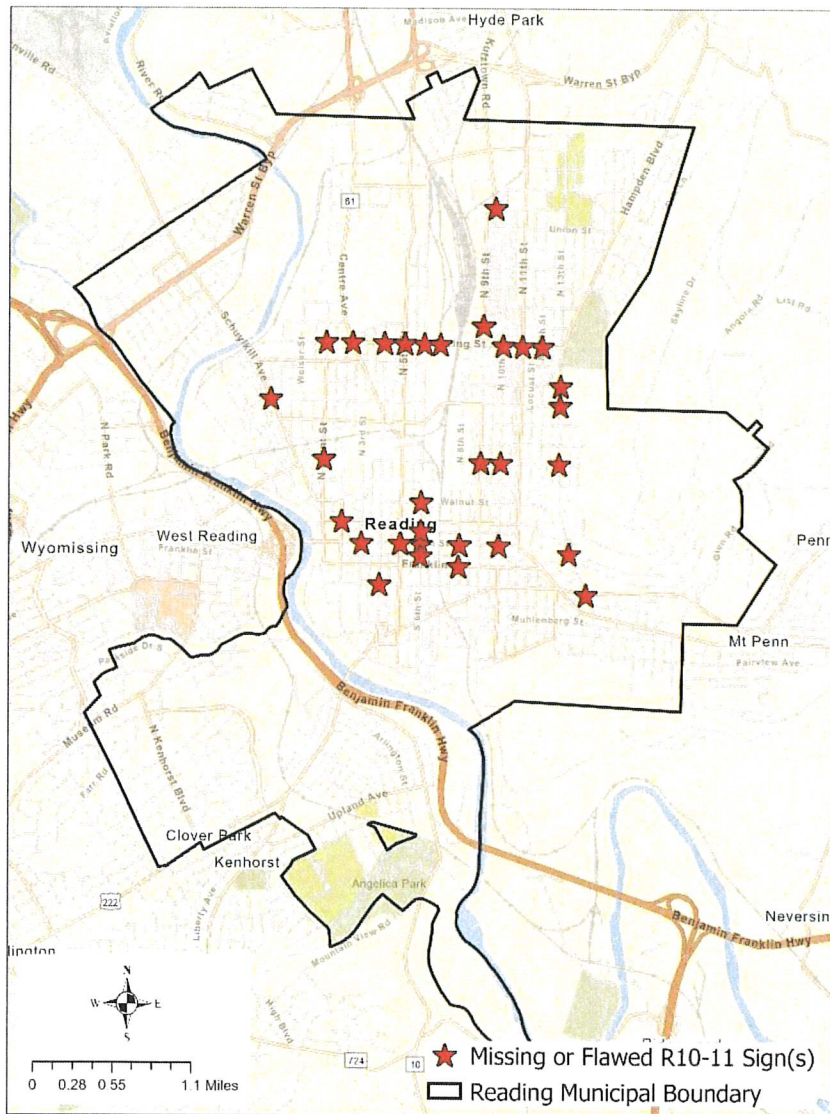
- Missing from field – 53 (41 - R6-2L and 12 - R6-2R respectively)
 - Estimated Replacement Cost Range - \$1,325 to \$11,925
 - Estimated Replacement Cost Average - \$4,320
- Condition Rating less than 3 – 109 (51 - R6-2L and 58 - R6-2R respectively)
 - Estimated Replacement Cost Range - \$2,725 to \$24,525
 - Estimated Replacement Cost Average - \$8,885



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R10-11 (No Turn on Red)

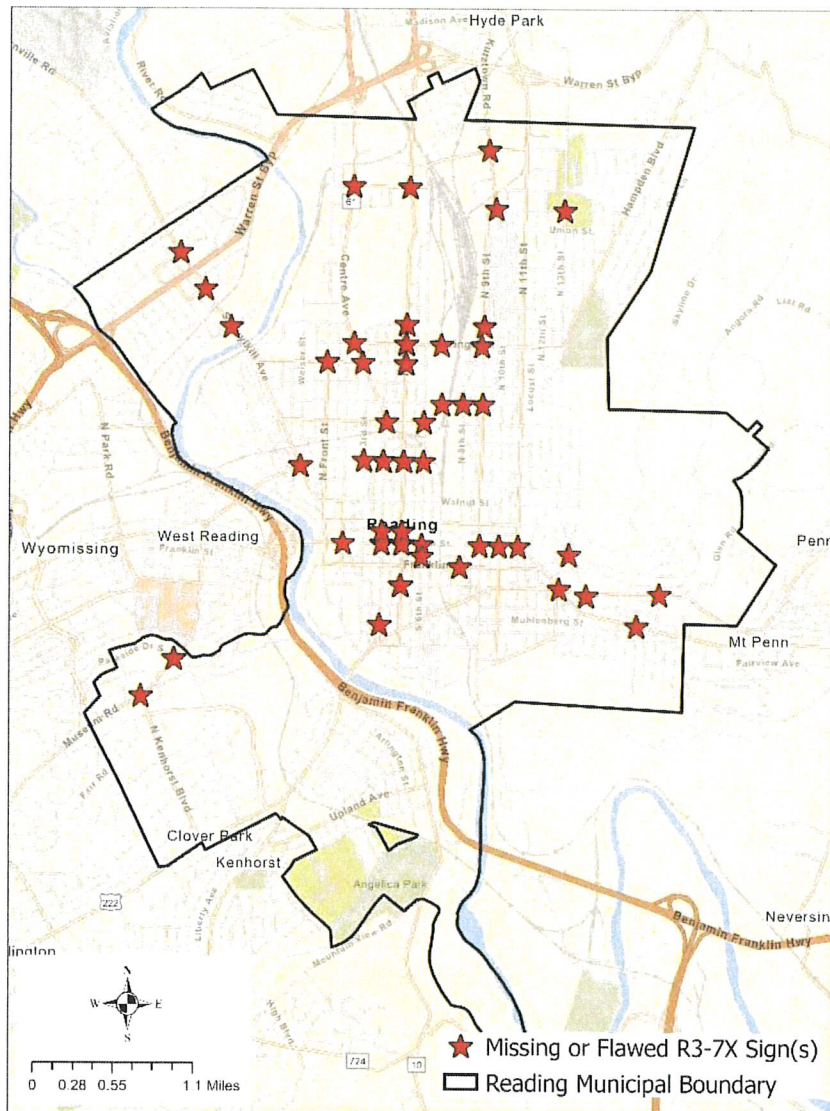
- Missing from field – 16
 - Estimated Replacement Cost Range - \$400 to \$3,600
 - Estimated Replacement Cost Average - \$1,305
- Condition Rating less than 3 – 30
 - Estimated Replacement Cost Range - \$750 to \$6,750
 - Estimated Replacement Cost Average - \$2,445



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R3-7L & R3-7R (Left Lane Must Turn Left or Right Lane Must Turn Right)

- Missing from permit – 31 (22 – R3-7L and 9 – R3-7R respectively)
 - Estimated Replacement Cost Range - \$775 to \$6,975
 - Estimated Replacement Cost Average - \$2,527
- Condition Rating less than 3 – 36 (30 – R3-7L and 6 – R3-7R respectively)
 - Estimated Replacement Cost Range - \$900 to \$8,100
 - Estimated Replacement Cost Average - \$2,934

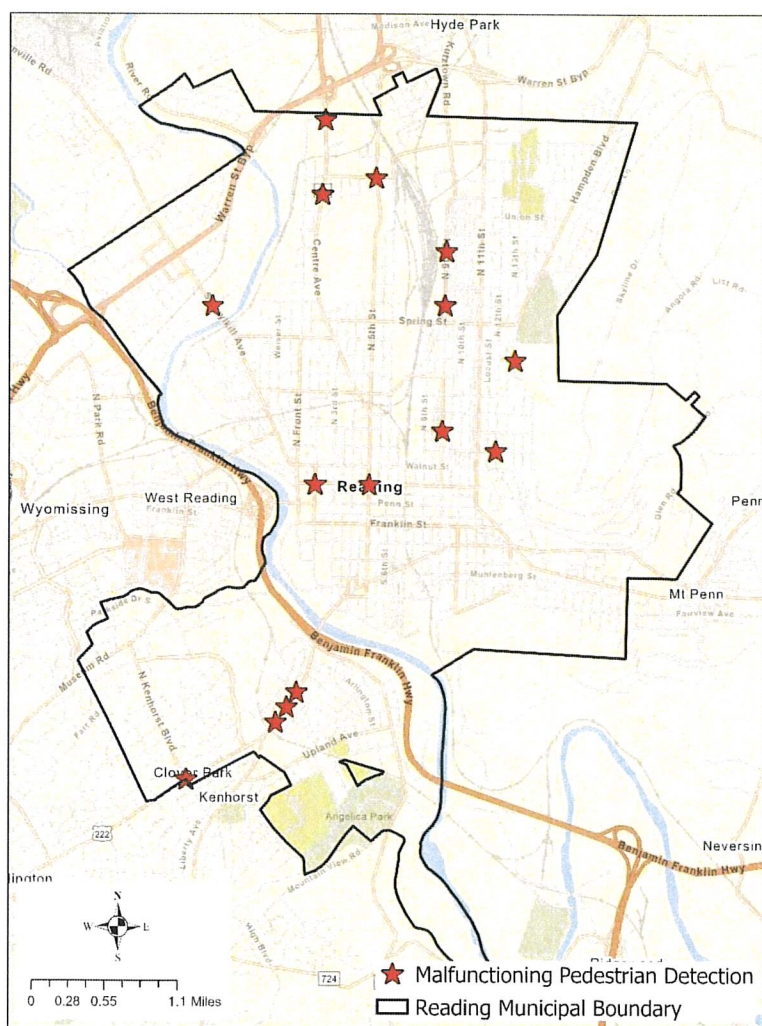


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Pedestrian Push Buttons

Pedestrian push button functionality is critical to not only pedestrians trying to cross an intersection but to vehicle traffic as well. If a push button is malfunctioning and continuously triggering a pedestrian cycle, this unnecessarily interrupts the flow of traffic. It also can potentially lead to a crash if a driver, who regularly travels through the intersection, assumes there is no pedestrian there is someone in the crosswalk. Another significant issue with a malfunctioning push button occurs when the button does not provide a walk cycle for the pedestrian at all. The pedestrian is left to determine an appropriate time to cross increasing the likelihood of an accident.

There were 41 push buttons rated with a Condition Rating of less than 3, with 35 of those being a Condition Rating of 1. Eight push buttons were noted as failing to register a walk cycle, while 14 were noted as jammed or otherwise (constantly registering a pedestrian).



According to ECMS, in District 5 over the last 2 years, a push button generally costs between \$256 and \$530 to replace. To replace all 41 push buttons, the cost would range from an estimated \$10,500 to \$22,000. To replace only the 22 malfunctioning push buttons, the cost ranges drops to an estimated \$5,600 to \$11,500.

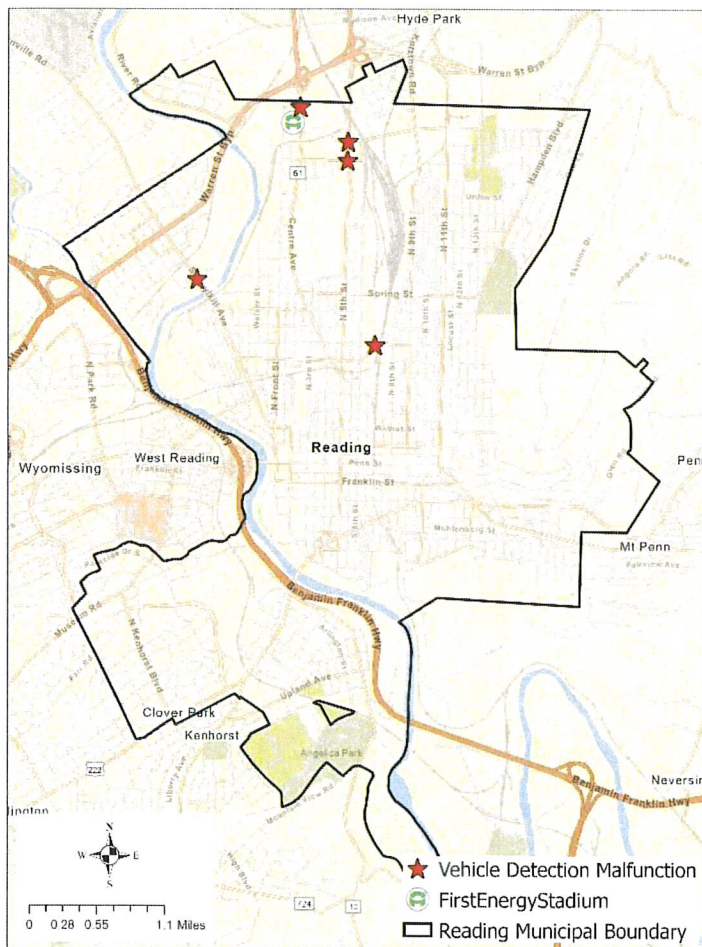
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Vehicle Detection

Vehicle detection, when installed and not functioning correctly, causes both traffic flow and safety issues. If a side street detector is registering a vehicle with no vehicle present, it unnecessarily interrupts the flow of traffic on the main route. This can also be an issue if the side-street detector does not trigger a signal change, leaving a driver to attempt to cross the intersection through a red indication.

There were 14 vehicle detection devices that were noted for failure. One device was not detecting vehicles and therefore the signal would not change for that leg of traffic. The city was notified by the inspector immediately and the city contacted their maintenance provider to have the issue repaired.

The other 13 issues noted surrounded the detector not functioning and the signal running through all cycles whether a vehicle was present or not. The City indicated that there were some complaints surrounding the First Energy Stadium (and difficulty getting to and from the venue for events). As indicated on map below, there are three signals with faulty detectors, leading to reduced functionality.

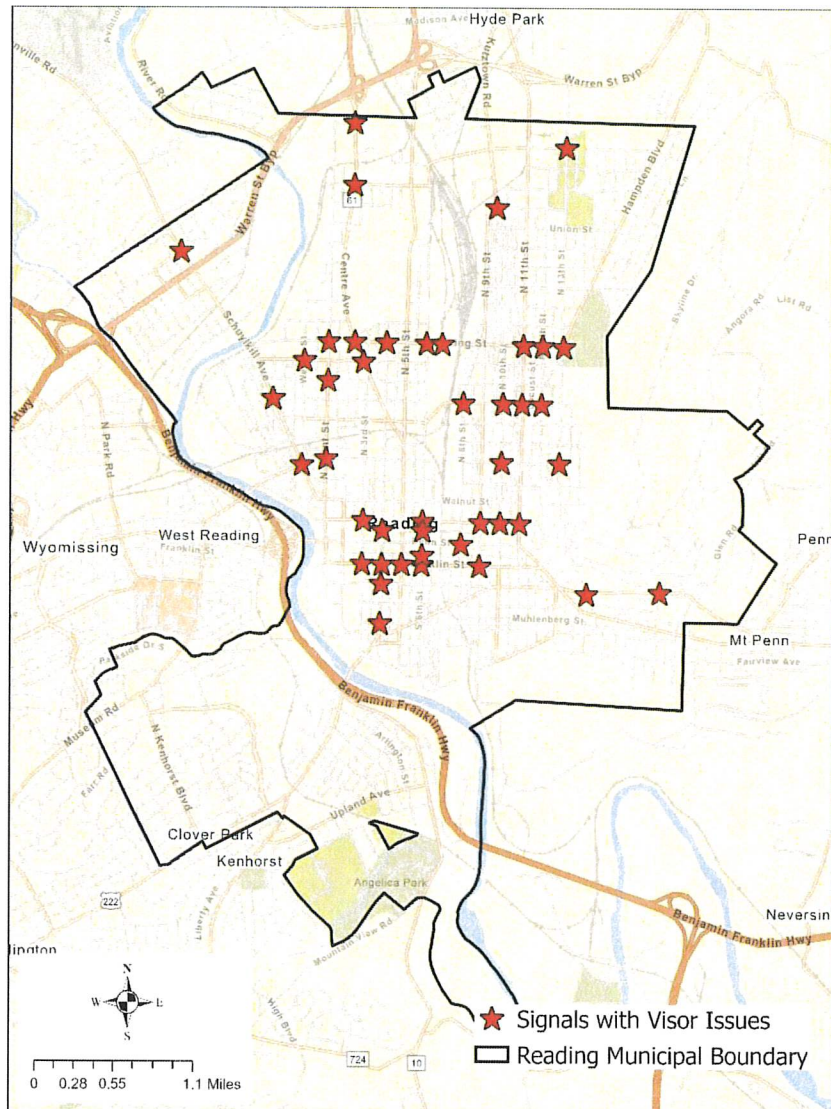


According to ECMS, the average cost to replace a loop sensor is between \$1,020 and \$3,750 with an average of \$3,131 per sensor. There may be other issues that may lead to a higher cost of replacement. Another consideration is the pavement degradation. A road surface that is cracked could result in the early failure of a loop sensor. In this case, another detection type such as video detection may be considered (according to ECMS, averages between \$2,250 to \$7,600 with an overall average of \$4,921).

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Signal Housings

Signal housings, and more specifically, missing/broken visors that surround the signal indication are a common issue across the City of Reading. These visors are critical to the ability of drivers and pedestrians to be able to see the indication at certain times of the day. A driver struggling to see the signal indication could lead to a crash and potential litigation. There are 43 signals with a total of 72 signal heads that have at least one damage or missing visor.



According to a local contractor, the approximate cost to replace the visors is \$150 per signal head for an estimated total of \$10,800 to replace these visors.

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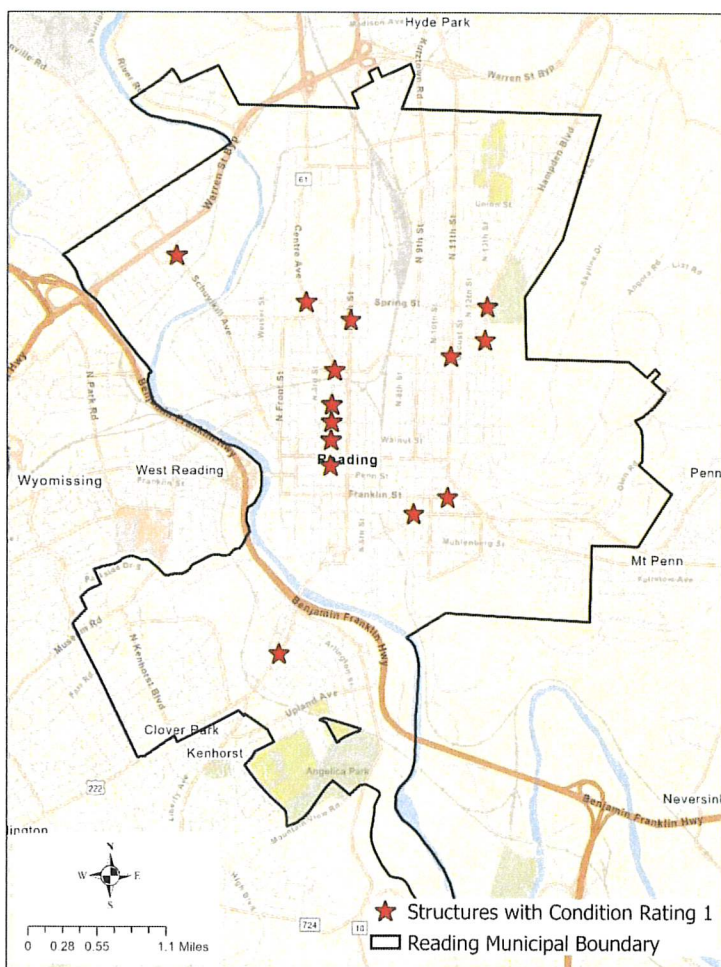
Medium Priority

These items are important but, due to the issue being more localized or having a higher cost to remedy, have been deemed medium priority.

Structures

Due to a recent failure of a traffic signal structure in another major city in Pennsylvania, there has been a renewed focus on traffic signal structures across Pennsylvania. Regular maintenance and/or inspection would have noted an issue with the foundation that led to its failure. A failure results in potential injuries and resulting litigation, emergency maintenance costs, and other unexpected expenses.

The City has 21 structures that were rated a Condition Rating of 1 either due to corrosion, dents, or leaning, with another 64 that had a Condition Rating of 2. Structures that have a Condition Rating of 2 should be subject to regular visual inspection and maintenance to prevent further issues. A visual inspection and possible structural analysis are recommended for any structure that is rated a Condition Rating 1 or has significant structural damage or corrosion.

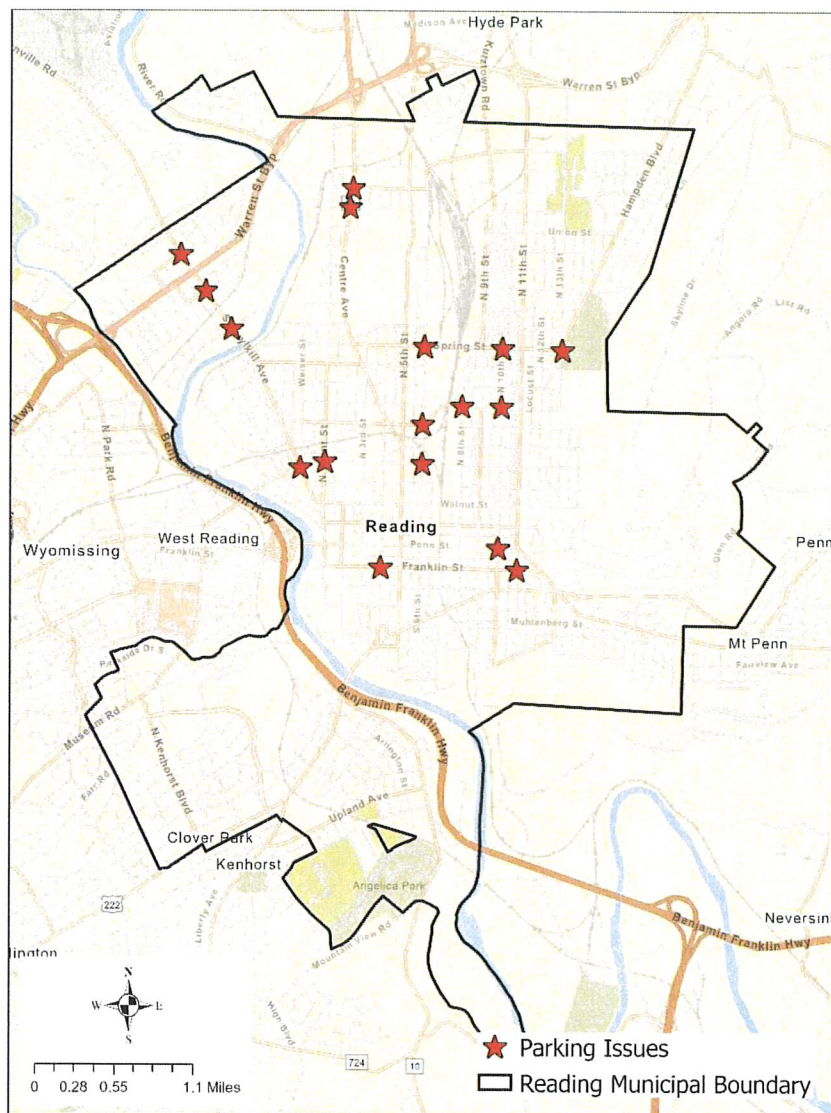


An estimated cost for a visual inspection and analysis is \$9,000 per structure. Another option is the total replacement of a structure. According to ECMS, the average cost to replace a signal support with mast arm ranges between \$10,250 and \$26,000 with the median being \$17,131.

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Parking Signs

Parking is deemed illegal by the City within 30 feet of a traffic signal or 20 feet from a crosswalk at an intersection. Due to missing or faded yellow paint and missing no parking signs this is a regular occurrence within the city. This could lead to a safety hazard for pedestrians, as it can be difficult for drivers and pedestrians to see each other around illegally parked vehicles. The map below depicts missing no parking signs and intersections noted, as identified in the MUTCD Compliance review.



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Individual Signal Issues

Below is a list of intersections with specific issues:

Intersection	Description
Lancaster Ave. and Angelica St.	The battery backup at this location has a bad battery. There is a notice on the backup of an issue and the battery connection is very corroded.
Chestnut and 3rd St.	The flasher does not have power as the circuit breaker for the device was tripped. This will cause a problem if there's an issue with the signal and it needs to enter flash at which point the signal will just go dark.
Rockland Rd. and 11th St.	A junction box lid is missing and is covered by an old piece of plywood. This lid or box should be replaced.
Bingaman St. and Lancaster Ave.	The battery backup at this signal was in "fail" mode.
Greenwich St. and 4th St.	Eight MUTCD Compliance Issues.
Schuylkill Ave. and Oley St.	Seven MUTCD Compliance Issues.
Rockland St. and Kutztown Rd.	Vehicular signal head is mounted directly above stop bar. Very inconsistent with approved signal permit it shows a mast arm at NE quadrant.
Buttonwood and 3rd St.	Old Traffic Signal Cabinet strapped to utility pole in this intersection and should be removed

Permits in Cabinets

The hardcopy permits in the signal cabinets were verified against the permits in TSAMS. The signals where the permit in the cabinet was older than the current version are summarized below:

1. Walnut St and Second St
2. Bingaman St and Lancaster Av
3. Fifth St and Bern St
4. Fourth St and Penn St
5. Eleventh St and Penn St
6. Fifth St and Washington St
7. Fifth St and Buttonwood St
8. Hampden Blvd and Thirteenth St

Remaining Suggestions

A detailed review of Attachment A and all the comments is strongly recommended. Below is a summarized list of additional suggestions:

1. Perform preventative maintenance on all signals yearly at a minimum, preferably every 6 months. A lot of the "smaller" issues can be remedied with regular maintenance.
2. Update Signal Permits to reflect current field conditions.
3. Replace remaining signs not previously mentioned.
4. Repaint Pavement Markings
5. Install vehicle detection at more intersections to help the flow of traffic.

City of Reading - Traffic Signal Maintenance Plan

Project Programming & Phasing

Assuming that all signal replacements will be funded with State grants, this is the recommended schedule for the next 3 years to address priority list.

Maintenance

The 2020 Reading City Budget had \$140,000 designated for Traffic Signal maintenance and repair. According to PennDOT Publication 191, it is estimated that a traffic signal costs between \$1,500 to \$6,000 for maintenance. Using the lowest estimate, annual maintenance on 130 traffic signals would cost \$195,000.

With maintenance costs alone exceeding the City's budget, maintenance for every signal, every year is impossible. Half of the signals should have maintenance completed by rotating sets of 43, 43, and 44 signals annually at a cost of around \$65,000. This should consist of a different set of signals each year to ensure that maintenance is being performed on each signal on a regular basis. In Year 1, it is strongly recommended that the intersections selected for maintenance should include signals with structures with a Condition Rating of 1.

Year 1

Item	Cost
Preventative Maintenance (43 Signals)	\$64,000
"Highest Priority" Signs (R3-7X, R10-11, R6-2X)	\$22,416
Push Button Replacement	\$11,500
Visor Replacement	\$10,800
Response Maintenance	\$31,284
Total	\$140,000

Year 2

Item	Cost
Preventative Maintenance (43 Signals)	\$64,500
Vehicle Detection Replacement	\$40,703
Response Maintenance	\$34,797
Total	\$140,000

Year 3

Item	Cost
Preventative Maintenance (44 Signals)	\$66,000
Parking Signs	\$10,350
Structure Assessment/Replacement	\$30,000
Response Maintenance	\$33,650
Total	\$140,000

City of Reading - Traffic Signal Maintenance Plan




Final Recommendation

It is recommended that the City hires, at minimum, one Traffic Engineer for Signal Systems. According to TSAMS, Reading has the fifth largest traffic signal system in the State of Pennsylvania behind the cities of Erie and Allentown. While those cities have a slightly larger signal systems, both of those cities have a dedicated traffic signal department. Having, at minimum, a traffic signal engineer would help maintain signal permits, ensure all signals meet current standards, schedule and track routine maintenance, and provide an evolving traffic signal maintenance plan.

This signal maintenance plan is a good starting point towards signal improvements across the city but having a person that is constantly analyzing the City's signal needs would guarantee that progress continues. Hiring any staff is a significant financial strain on any limited municipal budget. In this case, a staff member would help pay for themselves by freeing up Public Works department staff to focus on their respective responsibilities. They would also ensure that maintenance is performed, thus reducing more costly emergency maintenance and may reduce consultant expenses as well.

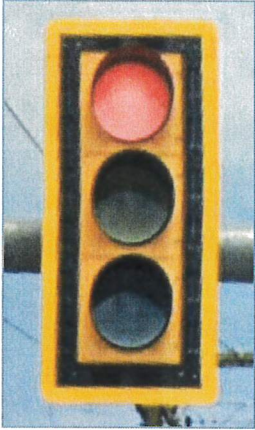

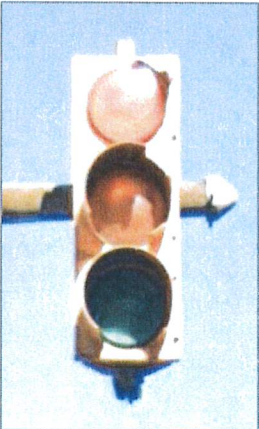
Appendix A: Condition Rating Examples by Signal Asset Category

Structures:

<p><u>Rating Level 3</u> New or Like New</p>	
<p><u>Rating Level 2</u> Minor Rusting</p>	
<p><u>Rating Level 1</u> Moderate Rusting & Dented or Damaged at Bottom (causing it to lean)</p>	

City of Reading - Traffic Signal Maintenance Plan

Signal Heads:

<p><u>Rating Level 3</u> New or Like New</p>	
<p><u>Rating Level 2</u> Red or Green Visor Chipped</p>	
<p><u>Rating Level 1</u> Visors Missing or Broken (causing the red indication to be difficult to see)</p>	

City of Reading - Traffic Signal Maintenance Plan




Signage:

<p><u>Rating Level 3</u> Colors are Sharp, and Sign is Easily Visible</p>	
<p><u>Rating Level 2</u> Cracked and Dull</p>	
<p><u>Rating Level 1</u> Very Faded and Bolts Show Signs of Heavy Corrosion</p>	

City of Reading - Traffic Signal Maintenance Plan

Preemption:

All items within the preemption category fell within the rating level 3.

<p><u>Rating Level 3</u> New or Like New</p>	
<p><u>Rating Level 2</u> Indication Light Pointing at the Ground</p>	
<p><u>Rating Level 1</u> Indication Light Missing</p>	

Vehicle Detection:**Rating Level 3**

Good Physical & Functional Condition (accurately detected vehicles)

**Rating Level 2**




Pavement is cracked and worn (leading to future failure) but accurately detected vehicles

**Rating Level 1**

FAULT indicator on in the cabinet and therefore not functioning correctly



Pedestrian Detection:

<p><u>Rating Level 3</u> Good Working Condition (accurately detected pedestrians)</p>	
<p><u>Rating Level 2</u> Paint Chipped and Button Worn (but functions as intended)</p>	
<p><u>Rating Level 1</u> Button Very Worn</p>	

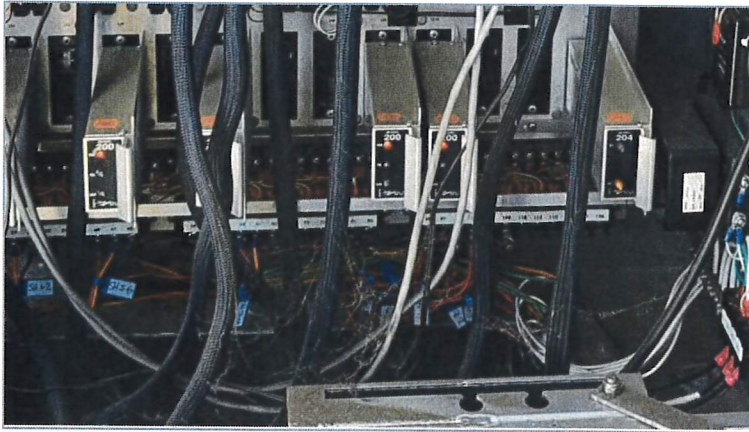
City of Reading - Traffic Signal Maintenance Plan

Cabinet:**Rating Level 3**

Cabinet and filter are clean, and light is working properly; free from damage

**Rating Level 2**

Cabinet is dirty which could lead to equipment failure

**Rating Level 1**

Cabinet is bent along with the structure; a significant gap existed at the bottom of the door; it was very difficult to close and was not mounted firmly to the structure.



City of Reading - Traffic Signal Maintenance Plan

Pavement Markings:**Rating Level 3**

Crosswalk, stop bar, and center line are in good condition

**Rating Level 2**

Crosswalk and stop bar slightly worn but still functional

**Rating Level 1**

Crosswalk and stop bar very worn



City of Reading - Traffic Signal Maintenance Plan

Junction Boxes:

<p><u>Rating Level 3</u> Very good condition</p>	
<p><u>Rating Level 2</u> Lid is cracked and corroded</p>	
<p><u>Rating Level 1</u> Lid missing and replaced with worn piece of wood</p>	